

# Transmission Reliability

Distributed Energy Resources (DER) are a suite of onsite, grid-connected or stand-alone technology systems that can be integrated into residential, commercial, or institutional buildings and/or industrial facilities. These energy systems include distributed generation, renewable energy, and hybrid generation technologies; energy storage; thermally activated technologies that use recoverable heat for cooling, heating, or power; transmission and delivery mechanisms; control and communication technologies; and demand-side energy management tools. Such decentralized resources offer advantages over conventional grid electricity by offering end users a diversified fuel supply; higher power reliability, quality, and efficiency; lower emissions; and greater flexibility to respond to changing energy needs.

**T**he U.S. electric power system is in the process of restructuring from a centrally planned and controlled system to a network dependent on competitive market forces for investment and operation. The Transmission Reliability (TR) program is developing advanced technologies, such as software programs and reliability-analysis tools, to support grid reliability and efficient markets during this transition.

Full competition requires providing energy production and use options to the individual customer. Distributed energy resources in the form of generation, storage and demand control provide this choice. The TR program's development of Real-Time Grid Reliability Management systems and control strategies employ the types of advanced information technologies, sensors, electronics, and high-speed telecommunications that can also support the integration of DER technologies into the electric power system. The program supports Real-Time Grid

Reliability Management through the development of operational decision support tools, and visualization and monitoring software programs with data from the Wide-Area Measurement Systems (WAMS).



Power Lines

WAMS uses a network of satellite-synchronized sensors that provides information to enhance the reliability of grid operation and the efficiency of electricity markets. A prototype WAMS network was in place on the Western system during the August 10, 1996 blackout. If a fully operational network had been in place, it could have mitigated the extent of the blackout, and avoided approximately \$230 million in outage costs.

Reliability-analysis tools assist transmission system operators with management of real-time grid operations. Some of the tools under development include visualization systems that display deviations from and corrections for transmission voltages, system frequency, power flow between regions, and generator reliability performance.

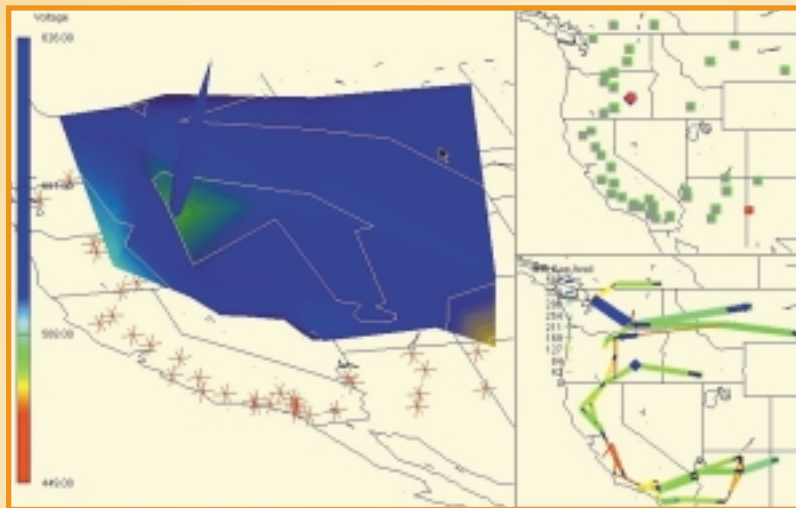
## Market Potential

- ▶ Aggregated customer load can be controlled with TR tools to lower customers' energy costs and reduce the load in system emergencies.
- ▶ Advanced TR technologies can be used in a microgrid—a local electric grid powered by DER technologies that can be integrated with or operated in isolation from the existing power system. Microgrids provide consumers with new technology options and U.S. industry with new markets. Microgrids integrated into the natural gas system also can help reduce U.S. reliance on oil imports.

## Environmental Benefits

- ▶ Unlike central power plants, many DER systems can be located in the heart of a community and in remote, environmentally pristine areas.
- ▶ A DER system—connected to the grid and managed by TR technologies—can reduce the run time of spinning reserves from fossil-fired generation.
- ▶ Use of DER technologies in place of standard power generating technologies can help reduce U.S. emissions of greenhouse gases and other air pollutants.

Under restructuring, the program is investigating how to integrate high penetrations of DER into the electric power grid, and into competitive electricity markets. DER technologies are active devices, such as microturbine generators and energy storage systems, which are installed on distribution (smaller-scale) systems, as opposed to transmission (larger-scale) systems. These devices are coordinated with load control, which responds to energy price and system emergency needs. DER can be installed to support local system management goals or to meet customer needs for increased power quality and reliability, and for lower energy costs.



VAR Monitoring Tool that allows for accurately monitoring and displaying grid voltages, identifying root causes of problems quickly, and taking swift action to remedy abnormal situations

## Applications

The current electric network connects users to central station power plants through an array of transmission and distribution wires. The emerging distributed power options offer the potential for providing clean and efficient electricity to the end user, and more energy choices to the customer. One of the most promising applications of DER is the microgrid, which could reliably power neighborhoods, industrial parks, or sub-sections of a larger grid. Microgrids would usually operate interconnected with the larger grid, selling energy and reliability services into competitive markets, but could also operate independently in system emergencies.

## Program Goals and Activities

The TR, Distributed Power, and Energy Storage Systems programs together focus on the reliable delivery of electric services to the consumer by integrating advanced technologies into transmission and distribution systems. The TR program develops advanced real-time control systems, and evaluates electricity and market system reliability interactions to enable full technical and economic integration of all electric supply technologies into the transmission and distribution system.

The R&D effort is accomplished in parallel with the Distributed Power program, which focuses on removing technical, economic, institutional, and environmental barriers to interconnecting distributed power resources into the grid, and the Energy Storage program, which integrates storage systems at the transmission and distribution systems to support reliability and power quality.

## For further information:

**Office of Power Technologies**  
[www.eren.doe.gov/power](http://www.eren.doe.gov/power)

**Distributed Energy Resources**  
[www.eren.doe.gov/der](http://www.eren.doe.gov/der)

**Transmission Reliability**  
[www.eren.doe.gov/der/transmission/](http://www.eren.doe.gov/der/transmission/)

## Partners:

**California Energy Commission**

**Economic and Reliability  
Regulatory Agencies**

**Independent Transmission  
System Operators**

**National Laboratories**

**Private Sector Companies**

**Trade Associations**

**Universities**

**Utilities**

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